DOE Distributed Power & Industrial DG Quarterly Review Meeting

October 23, 2001

Increasing the Use of DG in the Semiconductor Industry

Subcontract # 400006029

Barry Cummings, SRP

Responsible persons

- **Project Manager,**
  Barry Cummings
  SRP Phoenix Arizona
- **Technical Project Manager,**
  Tom Rizy,
  Oak Ridge National Lab

Hypothesis

- **Combining supplier & semiconductor FAB plant benefits significantly increases opportunities for D.G.**
- **Technical and economic changes in the next 5 to 10 years will provide new opportunities for D.G.**

Objectives

- **Create a management decision guideline**
- **Provide research tool for site-specific, feasibility studies**
- **Identify technical and economic improvements needed**
- **Estimate USA market**
- **Calculate total effects of increased number of DG's in Semi plants**

Alternatives within contract scope

- Gas Turbines
- Fuel Cells
- Alternative energy sources requiring energy storage

Other participants

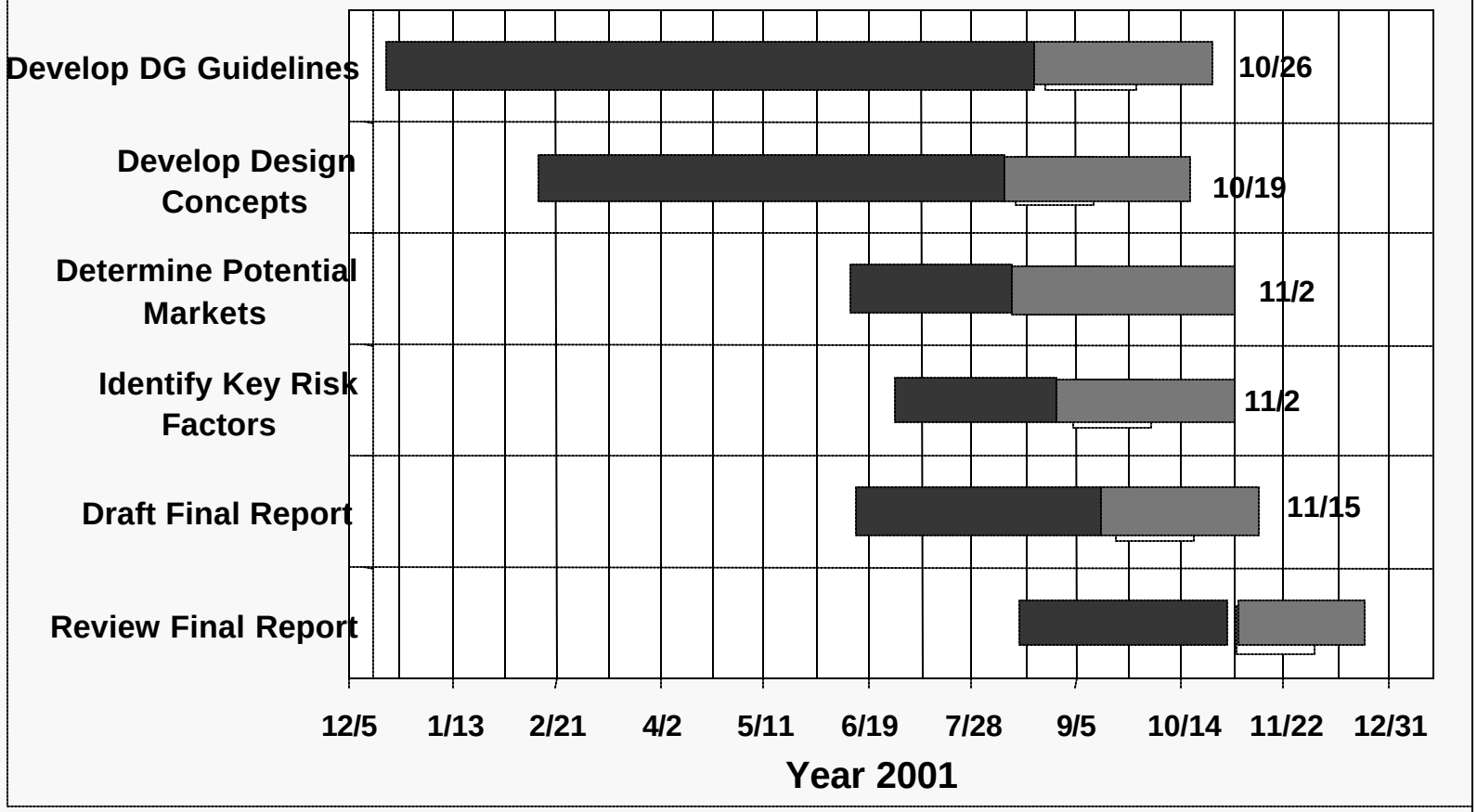
- **Black & Veach** (Subcontract) – Suqing Wang, Project leader
- **SEMATECH** – Walter Worth, Ram Mallela
- Volunteer work group includes:

  Intel – Phil Sarikas, Michael Bick, Marty Sedler

  Motorola - Phil Naughton

  AMD - Dan Smith

Gant chart


Develop DG Guidelines
10/26
Develop Design Concepts
10/19
Determine Potential Markets
11/2
Identify Key Risk Factors
11/2
Draft Final Report
11/15
Review Final Report
12/5
1/13
2/21
4/2
5/11
6/19
7/28
9/5
10/14
11/22
12/31
Year 2001

1. Guidelines

Task leader: Tom LaRose

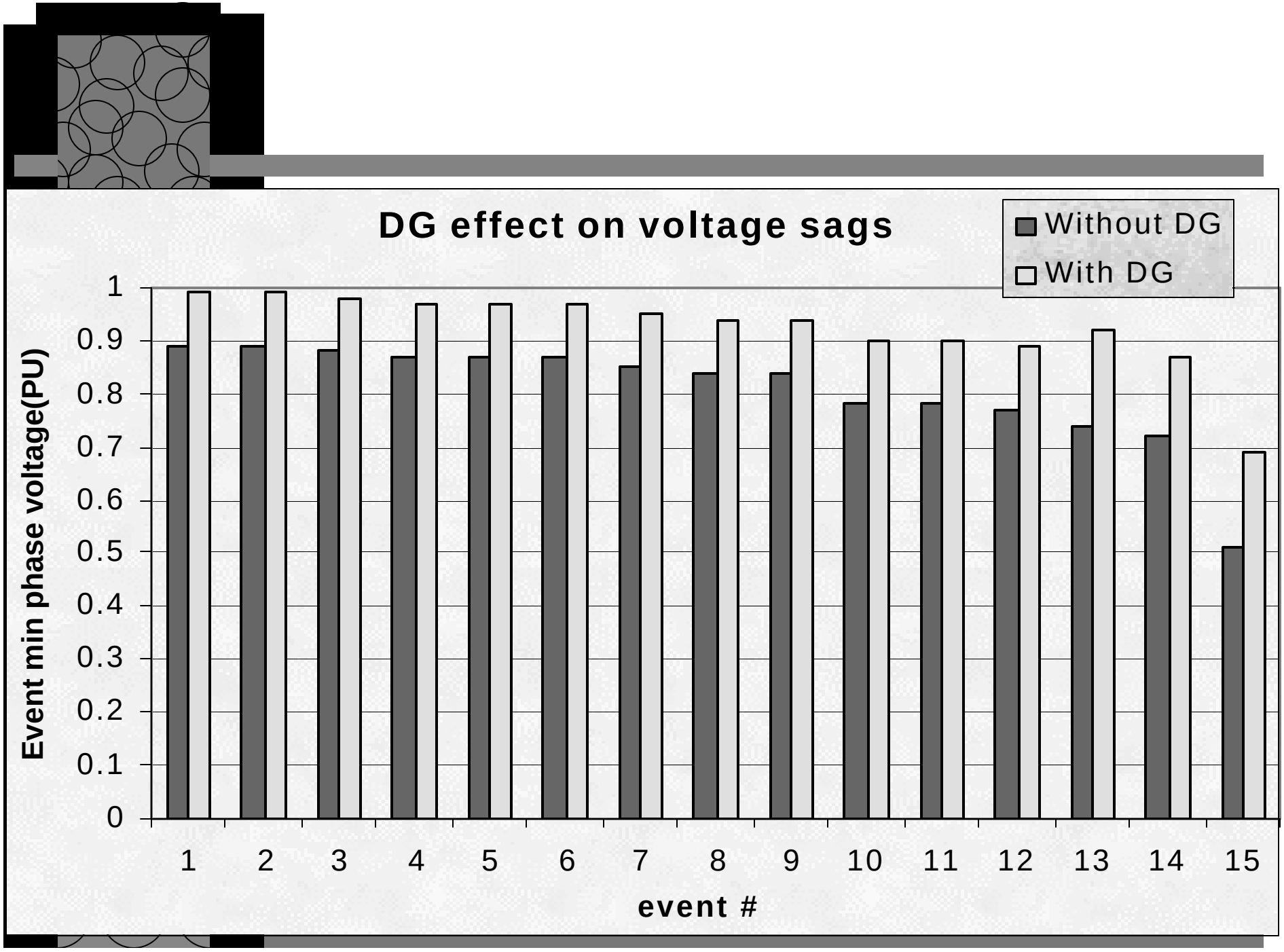
- **Environmental, Legal, and Institutional Issues**
- **Review of Distributed Generation Technologies**
- **Matrix of DG Requirements and DG Technologies**
- **Application Guidelines**

Task 1 Subtasks completed- Technical studies

- Probability risk assessment of redundant transmission line,
- Transient modeling of the CT for 1) load pick-up, 2) interruptions, 3) faults.
- Transient model CT effects on voltage sags
- Load flow program & loss model effect on network losses

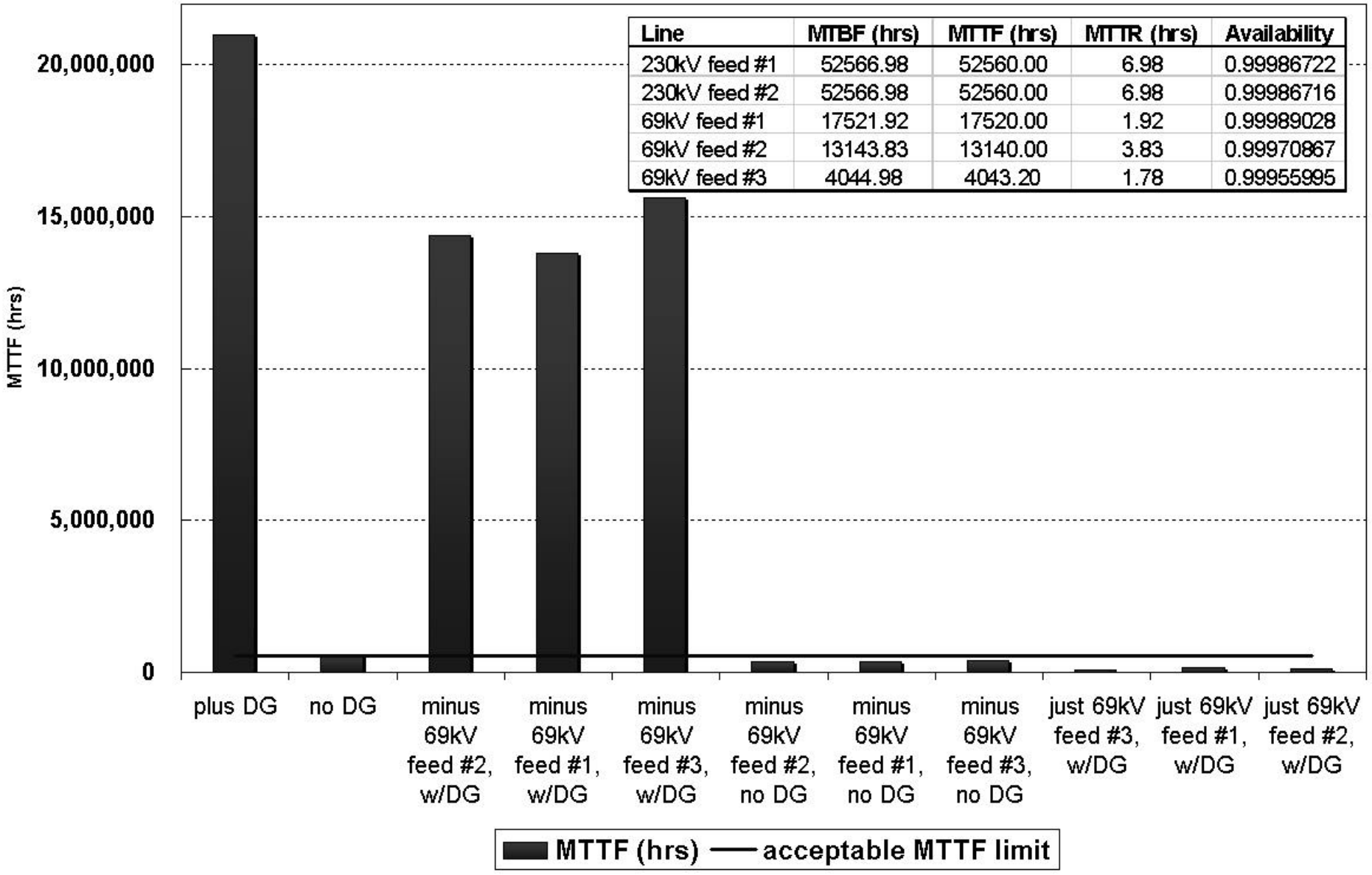
Task 1 Subtask – 2001 and 2007 costs & performance

- combustion turbines
- reciprocating engines
- fuel cells
- photovoltaics


DG effect on voltage sags
Without DG
With DG
Event min phase voltage(PU)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
event #

Calculated MTTF as a function of various supply scenarios

(base case = three 69kV sources, no DG)



Line	MTBF (hrs)	MTTF (hrs)	MTTR (hrs)	Availability
230kV feed #1	52566.98	52560.00	6.98	0.99986722
230kV feed #2	52566.98	52560.00	6.98	0.99986716
69kV feed #1	17521.92	17520.00	1.92	0.99989028
69kV feed #2	13143.83	13140.00	3.83	0.99970867
69kV feed #3	4044.98	4043.20	1.78	0.99955995

Calculated losses as a function of various supply scenarios

(base case = three 69kV sources, no DG; service disruption = $500K plus $750K/hr)

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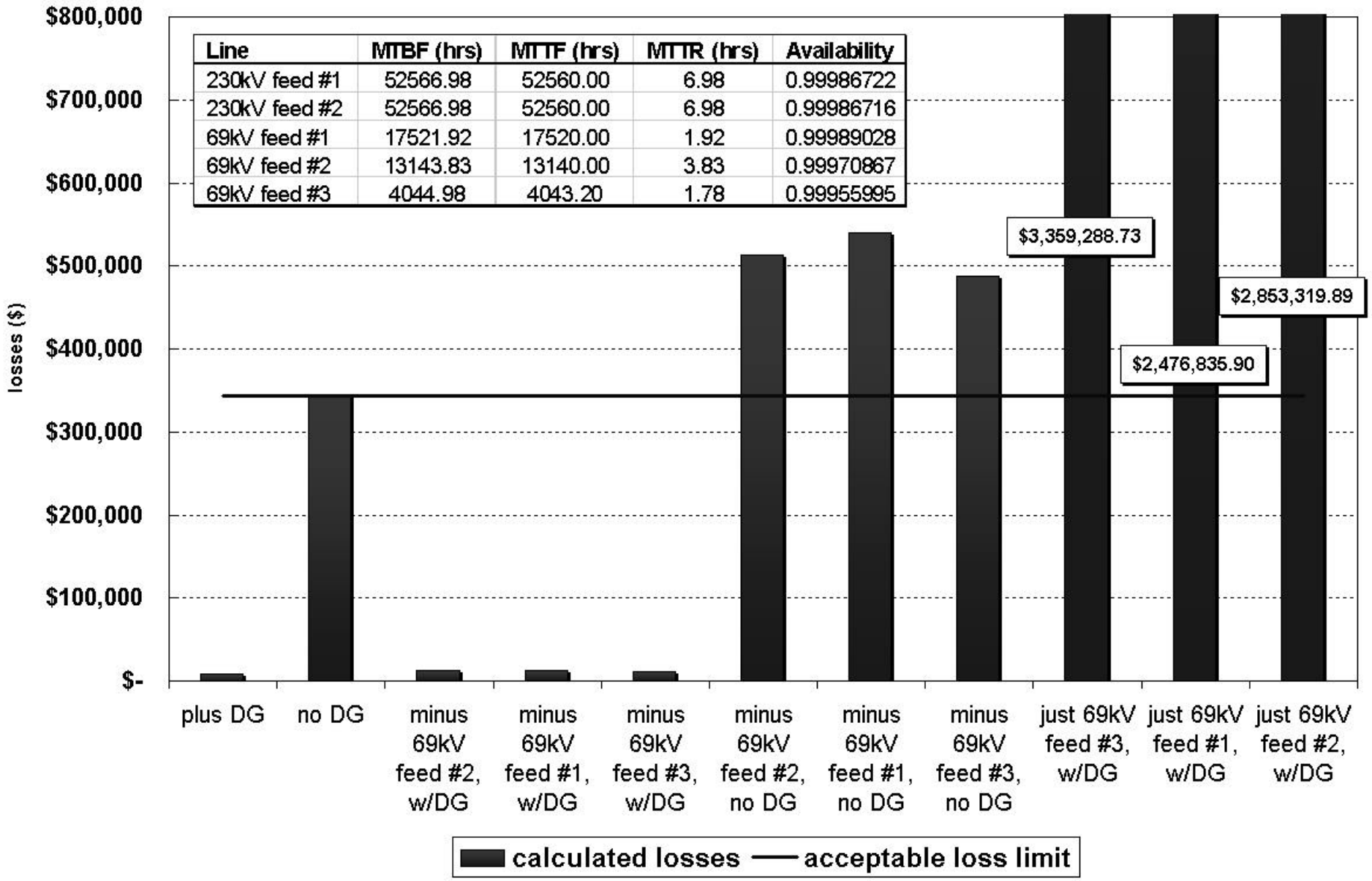


2. Develop Design Concepts

Task leader Bob Hess

- **Size major equipment**
- **Heat balance flow diagrams**
- **General Arrangement drawings**
- **Single line electric diagrams**
- **Economic analysis including operating costs**

Two alternatives: One GE LM 6000 or Two GE LM 2500

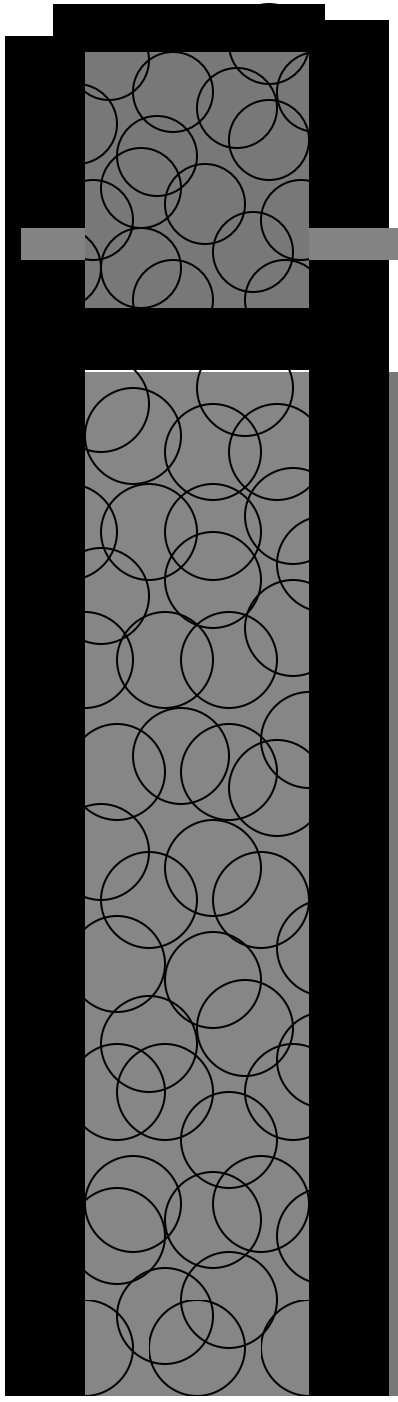
	CASE							
	2A	2B	3A	3B	4A	4B	5A	5B
1-GE LM 6000	X	X	X	X				
2-GE LM 2500					X	X	X	X
Cogeneration	X	X	X	X	X	X	X	X
Combined Cycle	X	X			X	X		
Simple Cycle			X	X			X	X
Steam Turbine Chillers	X		X		X		X	
Absorption Chillers		X		X		X		X

Task 2 completions - combustion turbine conceptual design

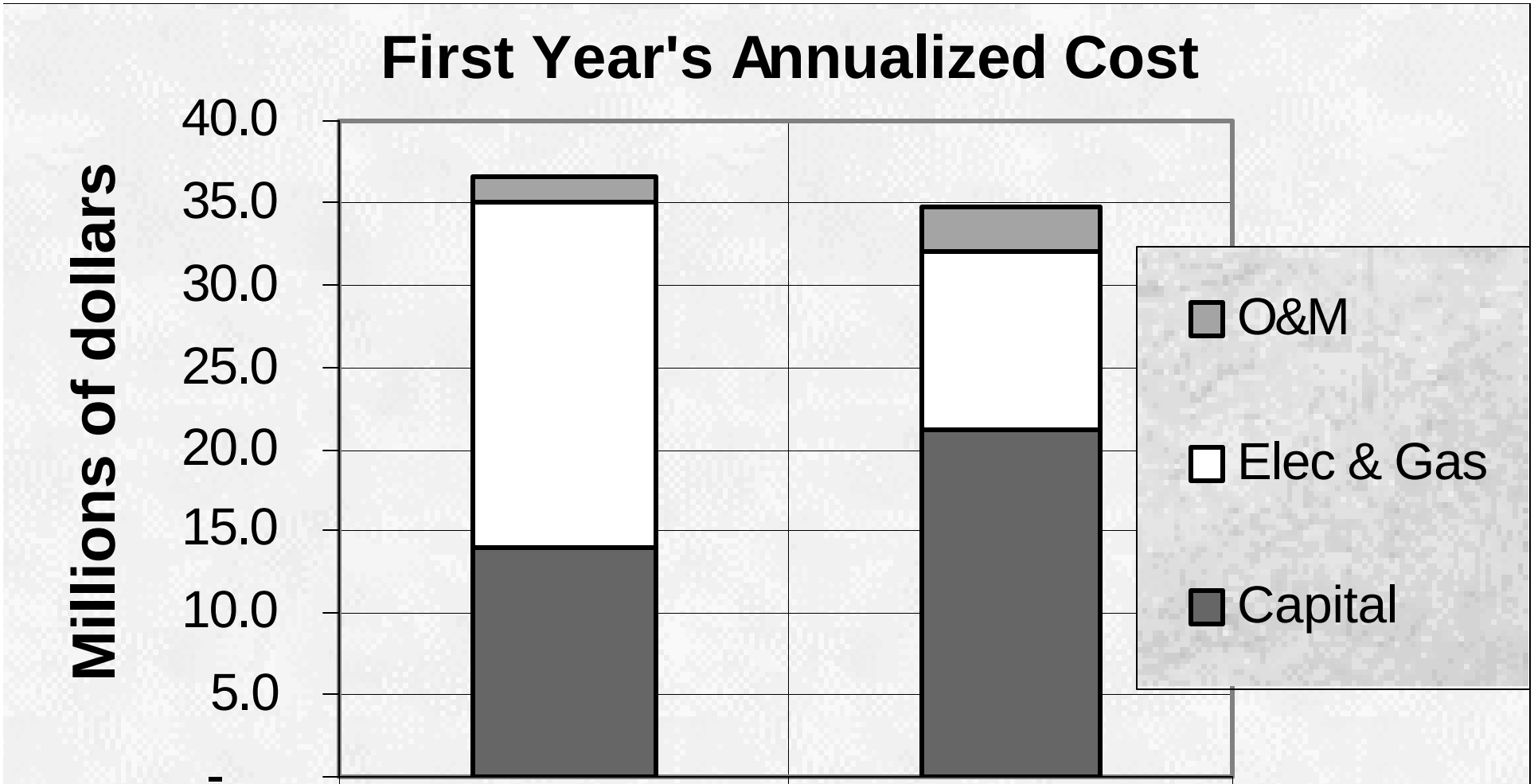
- Single line and flow diagrams
- Site arrangements
- Water consumption

- Estimates
- Performance Permitting requirements
- O&M and Capital cost estimates

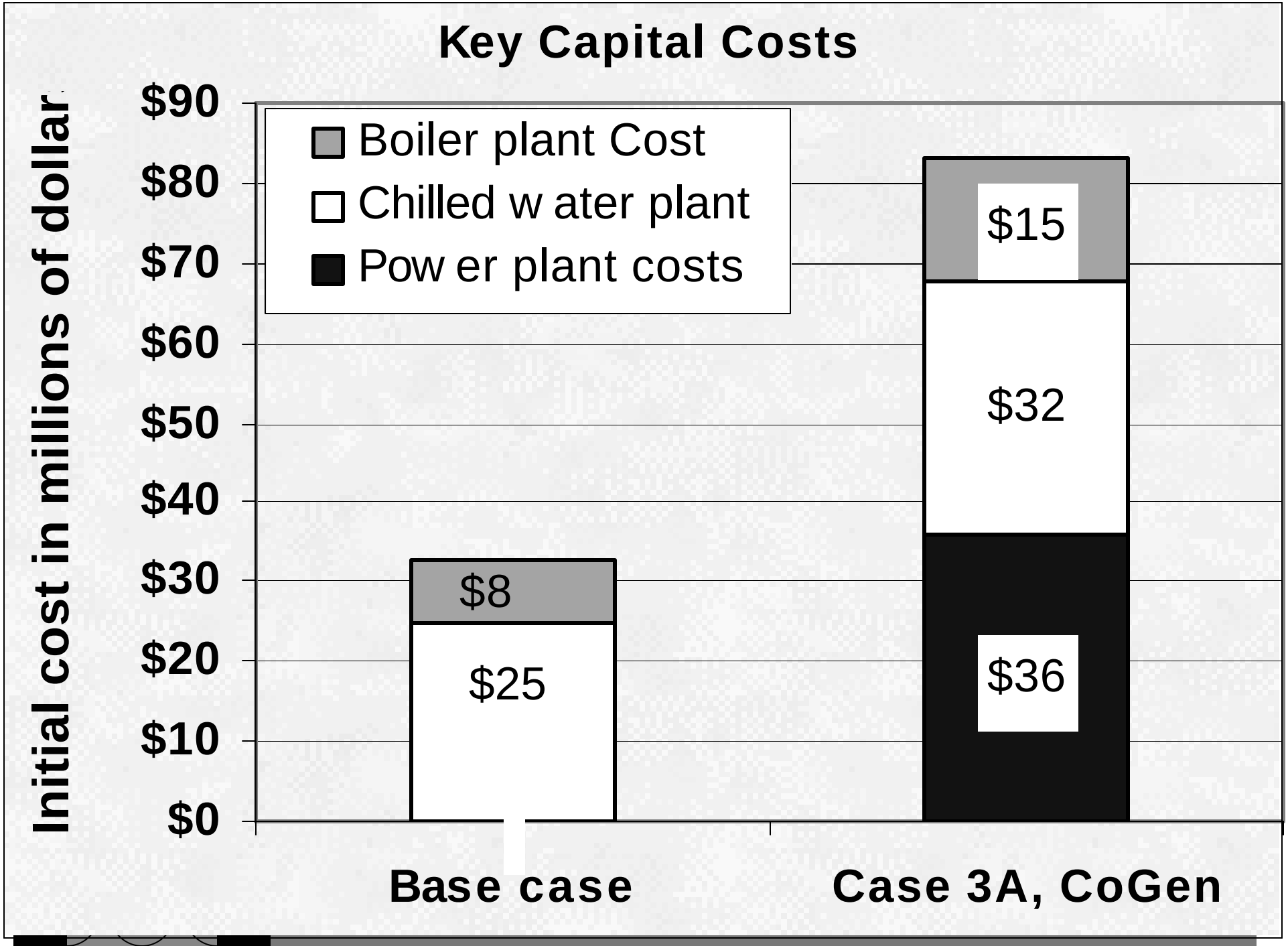
Task 2 completions - External requirements

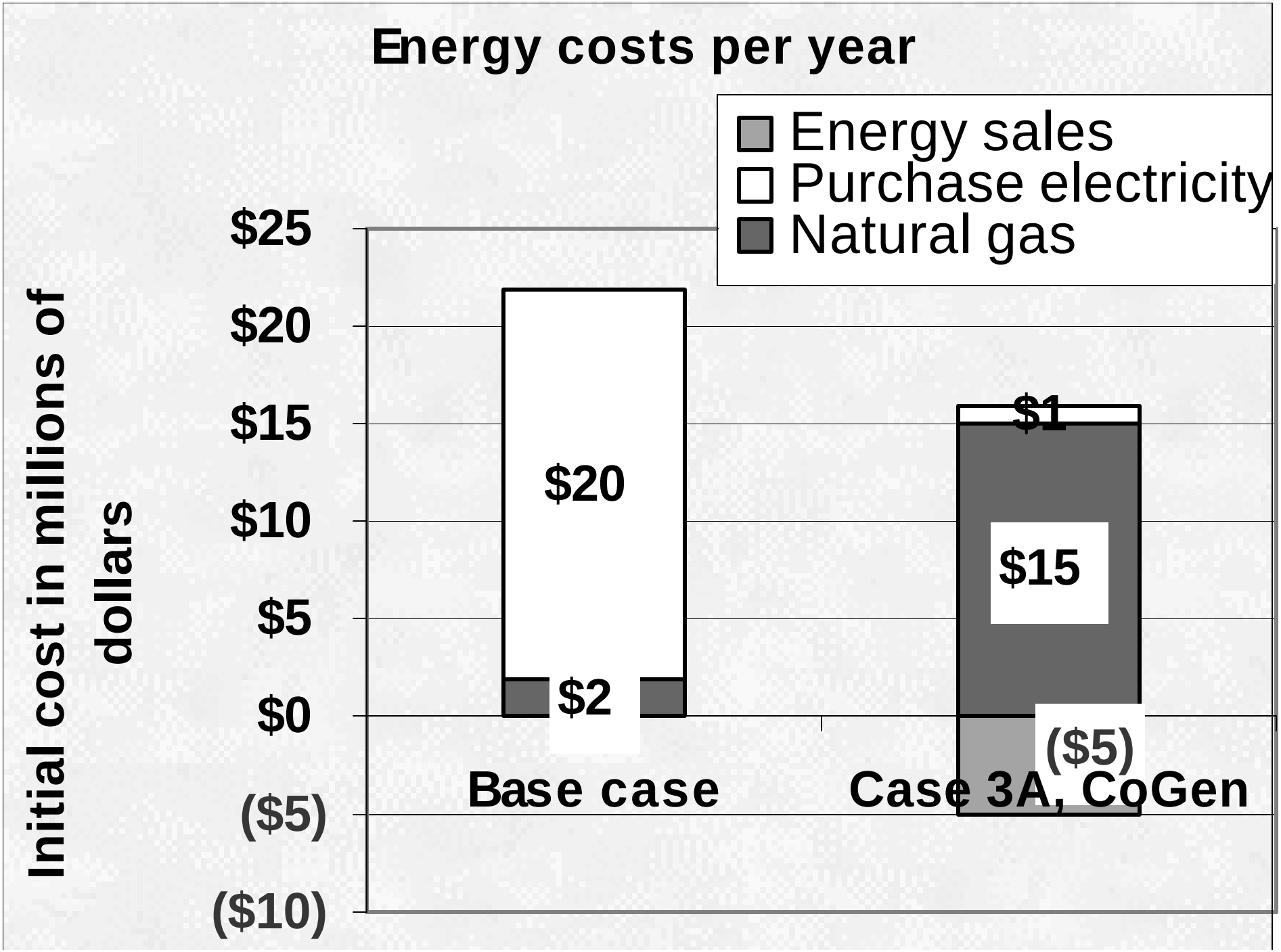


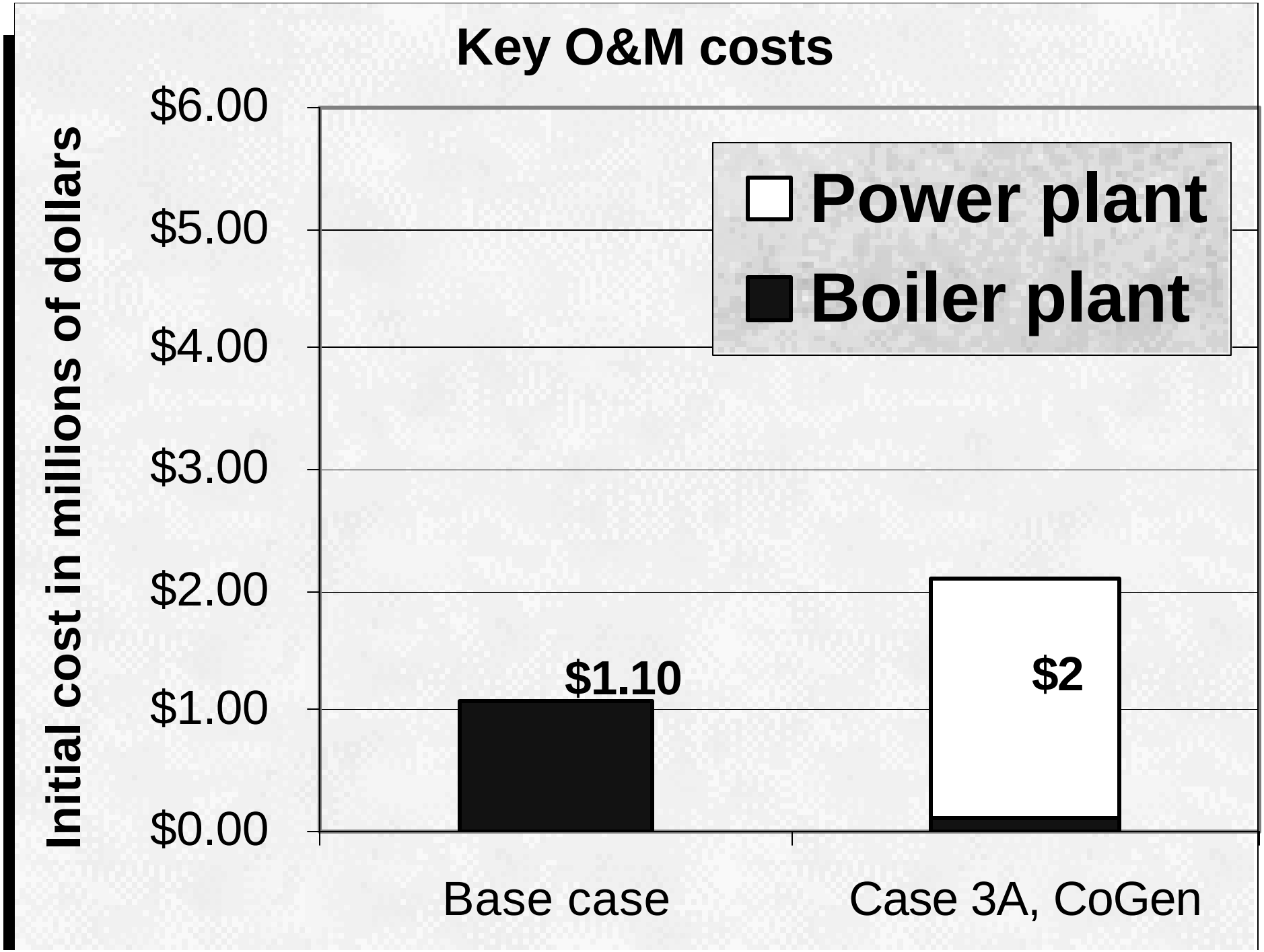
- Air & water quality Permitting Requirements
- Chemical accident prevention
- Zoning requirements building permits, local ordinances
- State Utility Commission Siting Requirements



	Case 1, No DG	Case 3, Cogen
O&M	1.6	2.6
Elec & Gas	21.1	10.8
Capital	13.9	21.2


Key Capital Costs
Initial cost in millions of dollar
$90
$80
$70
$60
$50
$40
$30
$20
$10
$0
Boiler plant Cost
Chilled w ater plant
Pow er plant costs
$8
$25
$15
$32
$36
Base case
Case 3A, CoGen


Energy costs per year
Energy sales
Purchase electricity
Natural gas
Initial cost in millions of dollars
$25
$20
$15
$10
$5
$0
($5)
($10)
$20
$2
$1
$15
($5)
Base case
Case 3A, CoGen

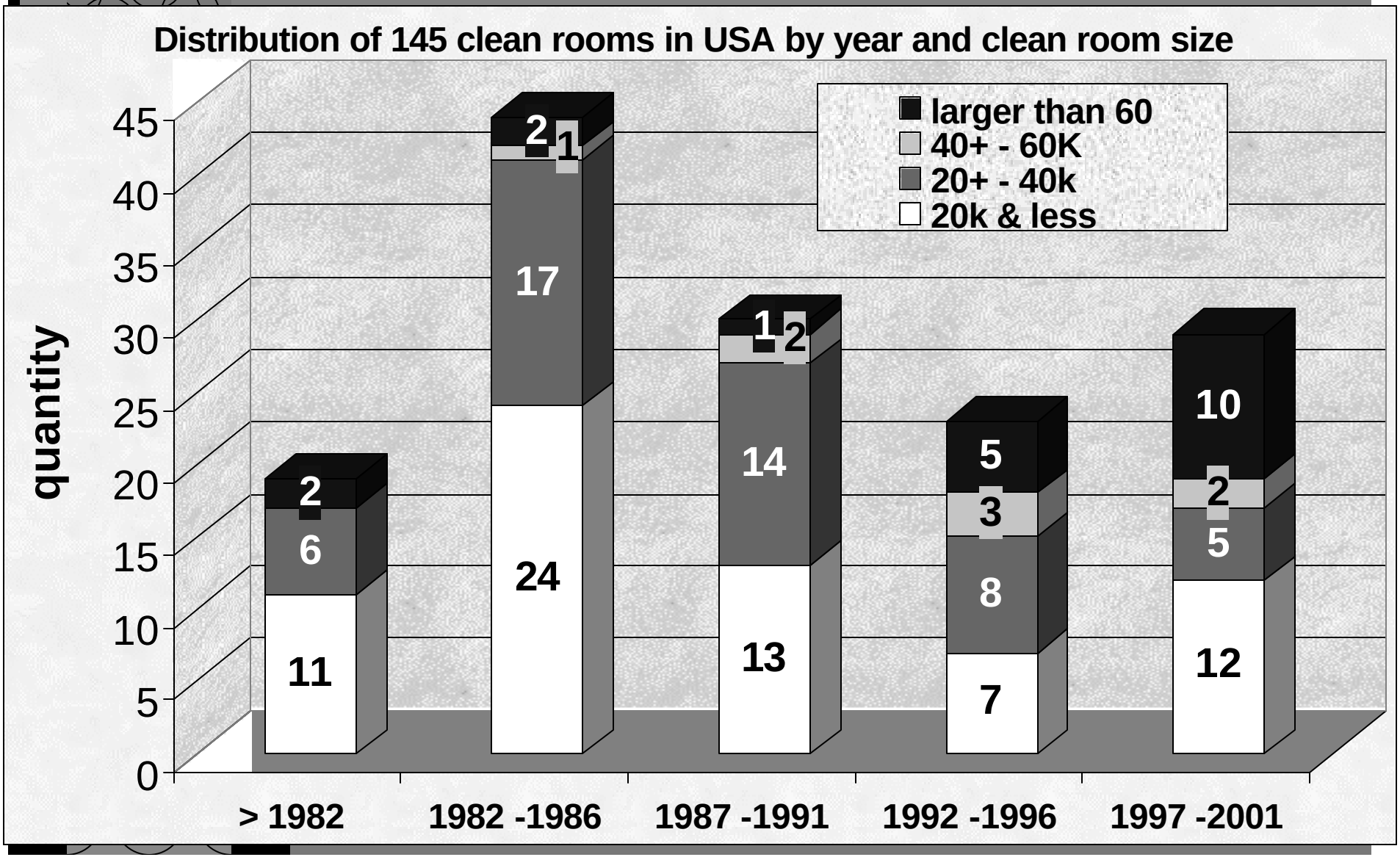

Key O&M costs
Initial cost in millions of dollars
$6.00
$5.00
$4.00
$3.00
$2.00
$1.00
$0.00
Power plant
Boiler plant
$1.10
$2
Base case
Case 3A, CoGen

3. Determine Potential Markets

Task Leader: Barry Cummings

- **Survey and forecast Potential Semi Market for Distributed Generation**
- **Macro Effects of USA Market Penetration**

Wordwide Fab Watch - July 2001 Issue:



4. Identify Key Risk Factors

Task Leader: Bob Hess

- **Identify and evaluate key risk factors**
- **Recommend R&D to reduce risk and increase acceptance of distributed generation**

Task 4 Sub task completions

- **Documentation of environmental & other external risks**
- **Contract with Comer & Associates – “Audit” of risks, conclusions, methods**
- **Identification of key variables**
- **Draft of decision requirements**
- **Thermal characteristics and related costs**

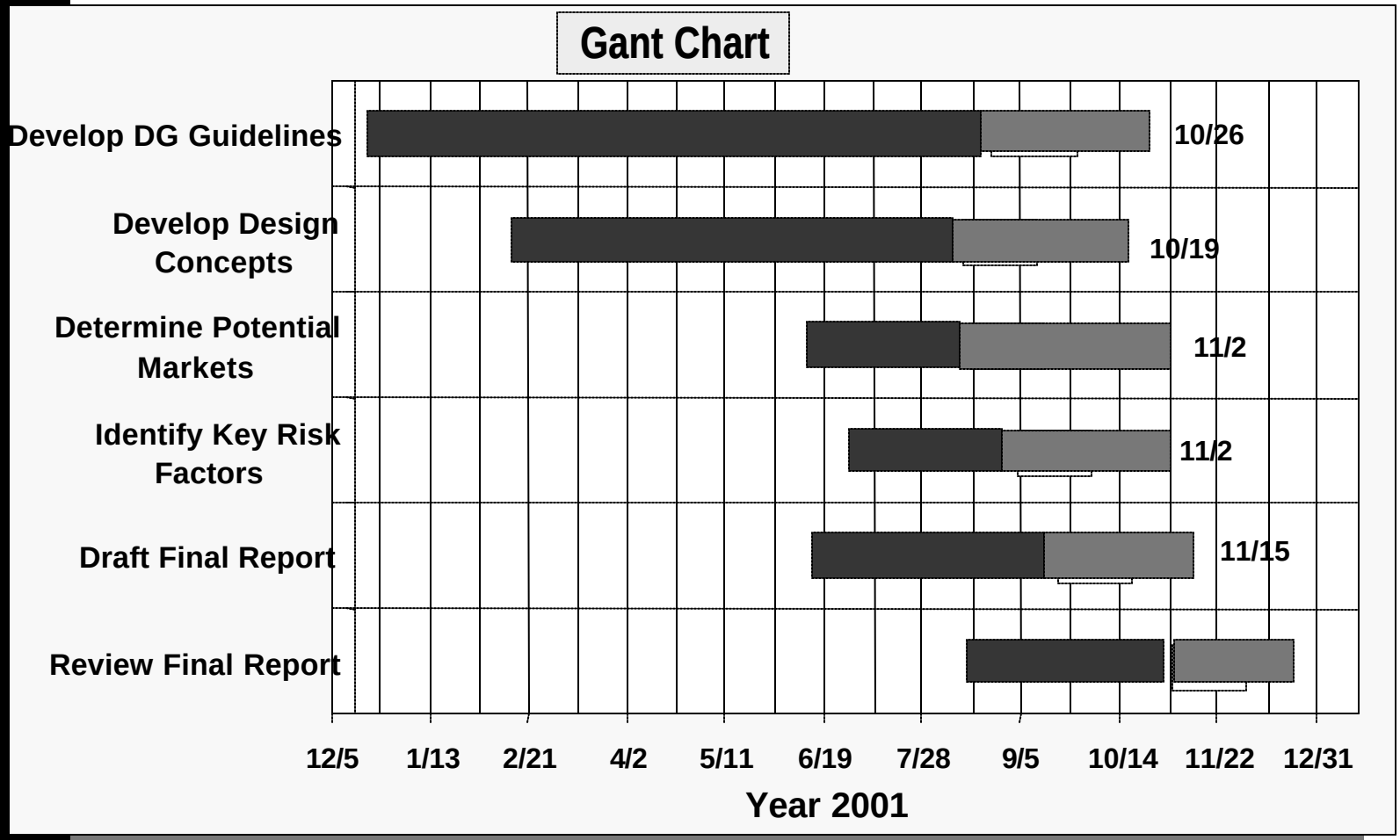
Task 4 completions - External risks

- National Environmental Policy Act
- Cultural, historic, and endangered species issues
- Public and government relations
- Regulatory and legislative developments

Schedule Challenges

- Creating drafts – manpower and format
- Concensus agreement on conclusions
- Scope of Task 3, Market
- Economic comparison assumptions
  - Social economics
  - Customer economics
  - Supplier economics
- Nature of semiconductor fab business

Gant chart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Year 2001